

Appl. No.10/563,009  
Amdt. Dated January 19, 2010  
Reply to Final Office Action of November 17, 2009

Attorney Docket No. 81844.0048  
Customer No. 26021

## REMARKS/ARGUMENTS

This application has been carefully reviewed in light of the Office Action dated November 17, 2009. Claims 1, 2, 4, 6, 7 and 9 remain in this application. Claim 1 is the independent Claim. Claims 1 and 4 have been amended. Claims 3, 5 and 10 have been canceled without prejudice. It is believed that no new matter is involved in the amendments or arguments presented herein. Reexamination and reconsideration of the application, as amended, are respectfully requested.

The present application is generally directed to a silicon based thin film solar cell including a silicon based low refractive index layer, a silicon based interface layer and a back electrode on the backside of a photoelectric conversion layer. (Applicant's specification, at FIG. 1).

## CLAIM REJECTIONS UNDER 35 U.S.C. § 103

Claims 1-7, 9 and 10 stand rejected under 35 U.S.C. § 103(a) as being obvious over Watanabe (US 4,781,765). Applicant respectfully traverses this rejection and amends claim 1 to clearly distinguish over all references of record. Claim 1 is amended to include the subject matter of claim 10, which depends from claim 3. Claim 1 reads as follows:

A silicon based thin film solar cell, wherein a conductive type silicon based low refractive index layer, a silicon based interface layer, and a back electrode are disposed and contact one another in this order on a backside of a photoelectric conversion layer observed from a light incident side, wherein the silicon based interface layer comprises a crystalline silicon component in the layer, wherein a most abundantly existing constituent element, excluding silicon, in the silicon based low refractive index layer is not less than 25 atomic %, wherein the silicon based low refractive index layer has a thickness of not less than 300 angstroms.

Applicant respectfully submits that claim 1 is not obvious because the cited references fail to teach or suggest that "wherein a most abundantly existing constituent element, excluding silicon, in the silicon based low refractive index layer is not less than 25 atomic %, wherein the silicon based low refractive index layer has a thickness of not less than 300 angstroms." As shown in FIG. 6 and disclosed in Example 3 of Applicant's specification, a higher thickness in the silicon based low refractive index layer advantageously provides a higher conversion efficiency of the thin film solar cell. Watanabe fails to disclose or suggest this feature.

Watanabe is directed to a photovoltaic device for resisting thermal degradation of conversion efficiency without deterioration of the initial conversion efficiency. An alloyed amorphous silicon first type n-sub-layer 3n<sub>11</sub> and an amorphous silicon second type n-sub-layer 3n<sub>12</sub> is provided. However, as disclosed in Table I and col. 3, lines 37-47, the thickness of the first type N-sub-layer is at most about 200 angstrom. Nakamura is cited for its relevance to hydrogen containing silicon layers and does not remedy the deficiencies of Watanabe in this regard.

Applicant notes that the Final Office Action has not answered Applicant's traversal with respect to the above feature. Instead, page 4 merely repeats verbatim the rejection in the Office Action of April 23, 2009. For the Examiner's convenience, the arguments presented in the amendment of July 16, 2009 are repeated below. Applicant requests that the rejection to be withdrawn on this basis if no rebuttal to Applicant's arguments are set forth.

Claim 1, incorporating the identical subject matter of dependent claims 5 and 10, requires the silicon based low refractive index layer to have a thickness of not less than 300 angstroms. The Office Action states that increasing the thickness of the low refractive index to increase the region for blocking undesired diffusion from

the back electrode would have been obvious since adjusting the result effective variable of thickness involves only routine skill. Applicant traverses this contention that increasing thickness is known to be a result effective variable.

In order to conclude that increasing thickness is a matter of routine experimentation, M.P.E.P. § 2144.05 states “A particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation. *In re Antonie*, 559 F.2d 618, 195 USPQ 6 (CCPA 1977) (The claimed wastewater treatment device had a tank volume to contractor area of 0.12 gal./sq. ft. The prior art did not recognize that treatment capacity is a function of the tank volume to contractor ratio, and therefore the parameter optimized was not recognized in the art to be a result- effective variable.).”

In Watanabe, there is no recognition that diffusion blocking is enhanced through increasing thickness. At best, Watanabe teaches “the first type n-sub-layer  $3n_{11}$  will block the diffusion of the undesired element.” (col. 3, lines 4-6). Increasing thickness is not recognized as the parameter by which diffusion blocking is accomplished. Therefore, it is equally plausible that the composition or the location of the layer  $3n_{11}$  is the result effective variable that blocks diffusion instead of thickness. Furthermore, there is no suggestion in Watanabe that the n-sub-layer  $3n_{11}$  can be thicker than 200 angstrom or recognition that higher thickness results in more diffusion blocking. Thus, applicant submits that thickness is not recognized in Watanabe as a result-effective variable such that one of ordinary skill would not find obvious to provide a thickness of at least 300 angstroms in the low refractive index layer. Applicant respectfully requests that evidence of the increasing thickness of the low refractive index layer increasing the blocking of undesired

diffusion from the back electrode in Watanabe be pointed out if the rejection is to be maintained.

The present invention, by contrast, recognizes that a larger thickness in the silicon based low refractive index layer results in a higher light trapping effect, which leads to higher conversion efficiency, as shown in applicant's FIG. 6. Such an effect is not disclosed or suggested in Watanabe.

Moreover, page 7 of the Final Office Action asserts that Table 1 does not teach unexpected results and requires further clarification and support. Applicant's disclosure at paragraph 0046 and Table 1 teaches a silicon based low refractive index layer of not less than 25 atomic % provides higher conversion efficiency. Importantly, an oxygen content of not less than 25 atomic %, corresponds to a refractive index of lower than 2.5, and results in a higher conversion efficiency. As shown in FIG. 1, one of ordinary skill would understand that oxygen concentration above 25% corresponds to a refractive index of less than 2.5, and when the refractive index is less than 2.5, the thin film solar cell shows higher conversion efficiency as demonstrated in FIG. 5. In view of Watanabe, this feature of the present invention provides unexpected results and demonstrates criticality (FIGs. 1 and 5, paragraphs 0048-0049). The unexpected advantages is enhanced through the combination of the silicon based low refractive index layer having the most abundant constituent element not less than 25 atomic % and the silicon based interface layer including a crystalline silicon component.

In view of the foregoing, it is respectfully submitted that the combination of Watanabe and Nakamura cannot render claims 1, 2, 4, 6, 7 and 9 obvious since they fail to teach or suggest each and every claim limitation. Accordingly, withdrawal of the rejections are respectfully requested.

Applicant believes the foregoing amendments comply with requirements of form and thus may be admitted under 37 C.F.R. § 1.116(b). Alternatively, if these

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amendments are deemed to touch the merits, admission is requested under 37 C.F.R. § 1.116(c). In this connection, these amendments were not earlier presented because they are in response to the matters pointed out for the first time in the Final Office Action.

Lastly, admission is requested under 37 C.F.R. § 1.116(b) as presenting rejected claims in better form for consideration on appeal.

In view of the foregoing, it is respectfully submitted that the application is in condition for allowance. Reexamination and reconsideration of the application, as amended, are requested.

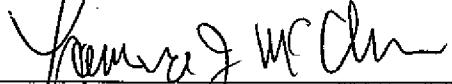
If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles, California telephone number (310)785-4600 to discuss the steps necessary for placing the application in condition for allowance.

If there are any fees due in connection with the filing of this response, please charge the fees to our Deposit Account No. 50-1314.

Respectfully submitted,

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